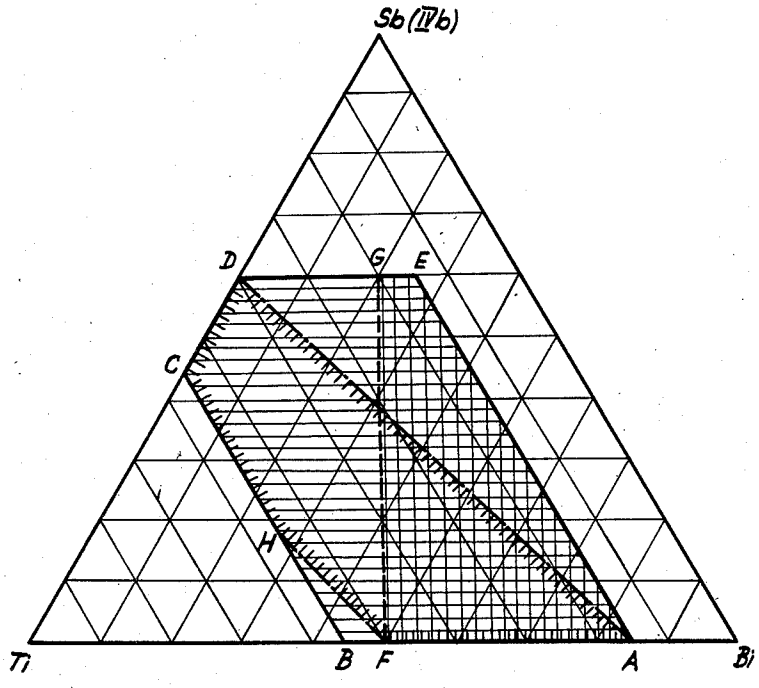
March 26, 1957 O. SMETANA ET AL 2,786,753

PYROPHORIC ALLOYS

Filed Feb. 16, 1954



INVENTORS
Otto Smetana et al
Hans Nowotny
Kurt Komarek

BY A. John Michel
ATTORNEY

United States Patent Office

2,786,753

Patented Mar. 26, 1957

2,786,753

PYROPHORIC ALLOYS

Otto Smetana, Hans Nowotny, and Kurt Komarek, Vienna, Austria

Application February 16, 1954, Serial No. 410,634

Claims priority, application Austria February 27, 1953

2 Claims. (Cl. 75—134)

It has been suggested already to employ titanium-bismuth alloys in the range of 30–80% titanium by weight as pyrophoric materials. There is no doubt that such alloys have pyrophoric qualities but with higher contents of titanium they are too hard to be technically usable. It has been found that the maximum titanium content in technically useful alloys is about 55%. On the other hand, alloys exist which contain less than 30% titanium and surprisingly are highly pyrophoric. The practically usable pyrophoric titanium-bismuth alloys range between 15% and 55% titanium; they are the subject of the present invention. The carrier of the ignition qualities is a phase consisting of approximately equal quantities of titanium and bismuth. With higher titanium contents, types of crystals higher in titanium occur, which due to their hardness render the alloys unusable. With small titanium contents the pyrophoric phase is diluted, so to speak, and the pyrophoric quality decreases, though surprisingly only at a slow rate. Even alloys with less than 15% titanium are still appreciably pyrophoric, though not sufficiently for practical use.

Furthermore, new pyrophoric alloys have been found which in addition to titanium and bismuth contain antimony and/or one or several of the elements of group IV*b* of the periodic system. Particular emphasis is to be laid on the alloys of the system titanium-bismuth-antimony and the system titanium-bismuth-lead. The addition of the inexpensive metals antimony and lead to the alloys is advantageous economically and can improve the service qualities of the alloys. E. g., an increased resistance to corrosion or better machining qualities may be obtained in that way. In the ternary diagram of the drawing the general range of the alloys according to the present invention lies within the lines A—B—C—D—E—A. For specific ternary systems that range is further restricted, e. g. for the system Ti—Bi—Pb: area A—F—G—E—A, and for the system Ti—Bi—Sb: area A—D—C—H—F—A.

Antimony and lead may be replaced partly or entirely by other elements of groups IV*b* and V*b* of the periodic system, but their pyrophoric effect is appreciably smaller. In addition to the elements mentioned hereinbefore, the alloys may contain one or several of the following elements:

(*a*) In a total not exceeding 20% by weight: Zr, Th, U, Ce and other rare earths;

(*b*) In a total not exceeding 10% by weight: Fe, Co, Ni, Mn, Al, Si, Cu, Ag, V, Cr, Mo, W.

Further the alloys may contain elements present as impurities in the alloying components (e. g. in the titanium metal) or added during the production or processing

of the alloys. They are the elements O, H, C, S, P, N.

The alloys may be produced in any desired way. The following example illustrates such procedure of production: 400 grams of titanium powder containing 99% titanium are mixed with 800 grams lead powder (99.95% pure) and 800 grams coarse bismuth powder and without addition of a binder are pressed in a hydraulic press to form buttons 30 mm. in diameter and 30 mm. high. 500 grams of said buttons in a cylindrical crucible of dense graphite having the dimensions: 48 mm. internal diameter, 60 mm. external diameter, length 300 mm., are inserted into a tiltable, entirely closed carbon-tube short-circuit furnace. The furnace space is evacuated down to 0.05 mm. Hg, pure argon is admitted to a pressure of 700 mm. Hg, and the electric power is connected. The current is initially 200 amp. and during 10 minutes is gradually increased to the final value of 500 amp. The final voltage is 27 volts. After 12 minutes the mass has been melted. The pressure in the furnace rises to 1400 mm. Hg. Melting the remainder of the buttons, which are gradually added to the melt by a suitable device, takes 25 additional minutes. After the melting has been completed the furnace is tilted whereafter the metal flows into the chill mould preheated to 500 deg. C.

Examples

Percent by weight	Ti	Bi	Sb	Pb	Zr	Ce	Fe	Mn	Al
1	29	71							
2	20	40		40					
3	30	50	20						
4	45	52		3					
5	40	30	30						
6	15	40		45					
7	47	10		43					
8	40	40		8		10	2		
9	30	50	8		10				2
10	35	35	28					2	
11	20	70			10				
12	47	53							

What is claimed is:

1. A pyrophoric material consisting essentially of titanium and bismuth in the proportions of 15 to 55% by weight of titanium and 20 to 85% by weight of bismuth, the combined amounts of titanium and bismuth being at least 55% of the material.

2. A pyrophoric material consisting essentially of titanium and bismuth in the proportions of 30 to 50% by weight of titanium and 50 to 70% by weight of bismuth.

References Cited in the file of this patent

UNITED STATES PATENTS

2,490,571 Anicetti ---------- Dec. 6, 1949

FOREIGN PATENTS

224,231 Germany ---------- July 11, 1910

172,660 Austria ---------- Oct. 10, 1952

OTHER REFERENCES

Journal of Metals, March 1950, vol. 2, page 488.

Journal of Metals, September 1951, vol. 3, pages 772–773.

"Explosive Characteristics of Titanium, Zirconium, Thorium, Uranium and Their Hydrides," Bureau of Mines Report of Investigations 4835, U. S. Dept. of Interior, December 1951, pages 1, 2 and 16.